Install

Front Gear Train

Piston Grading

**NOTE:** B4.5 RGT engines do not require piston grading.

When rebuilding an engine with the original cylinder block, crankshaft, and pistons, make sure the pistons are installed in the original cylinder.

If replacing the piston(s), make sure the replacement piston(s) are the same grade as the original piston.

If a new cylinder block or crankshaft is used, the piston grading procedure **must** be performed to determine the proper piston grade for each cylinder.

The cylinder block and all parts **must** be clean before assembly. Refer to **Procedure 001-026** to inspect the cylinder walls of the cylinder block. Use a clean, lint-free cloth to clean the connecting rods and bearing shells.
CAUTION

The connecting rods and connecting rod caps are not interchangeable. The connecting rods and connecting rod caps are machined as an assembly. Failure will result if the connecting rods and caps are mixed.

CAUTION

Make sure not to damage the mating surfaces of the fracture-split connecting rods and the rod caps.

NOTE: Fracture split connecting rods use a different upper and lower bearing.

Install the bearing shells into both the connecting rod and the connecting rod cap.

Make sure the tang on the bearing shells is in the slot of the connecting rod cap and connecting rod.

NOTE: The fracture surface on the fracture split connecting rod and connecting rod cap must be kept dry and clean to make sure proper mating of the two surfaces is maintained.

Lubricate the connecting rod bearings with a light film of assembly lubricant, Part Number 3163087.
Lubricate the rings and piston skirts with clean engine lubricating oil.

Position the rings so that the ring gaps are 120 degrees apart.

**NOTE:** The ring gap of each ring must not be aligned with the piston pin, or any other ring. If the ring gaps are not aligned correctly, the rings will not seal properly.

**CAUTION**

If using a strap type ring compressor, make sure the inside end of the strap does not hook on a ring gap and break the ring.

For B3.9, B4.5, and B5.9 engines, use piston ring compressor, Part Number 3164330, to compress the rings.

For B4.5 RGT engines, use piston ring compressor, Part Number 4918294, to compress the rings.
Lubricate the cylinder bore with clean 15W-40 lubricating engine oil.

Position the connecting rod journal for the piston to be installed to bottom dead center (BDC).

**WARNING**

Failure to follow this step will result in extensive engine damage.

Align the “front” marking and/or arrow on the top of the piston so that it points towards the front of the engine.

Insert the connecting rod through the cylinder bore until the ring compressor contacts the top of the cylinder block.

The long end of the connecting rod (1) will be on the exhaust side of the engine. If **not**, verify the piston is installed correctly onto the connecting rod.
Hold the ring compressor against the cylinder block.

Push the piston through the ring compressor and into the cylinder bore.

Push the piston until the top ring is completely in the cylinder bore.

**NOTE:** If the piston does not move freely, remove the piston and inspect for broken or damaged rings.

Take care to **not** damage the cylinder wall when inserting the connecting rod.

Carefully push the piston into the bore while guiding the connecting rod to the crankshaft journal.

**NOTE:** The fracture surface on the fracture split connecting rod and connecting rod cap must be kept dry and clean to make sure proper mating of the two surfaces is maintained.

Verify the tang of the bearing (2) is in the slot of the cap (1).

Use assembly lube, Part Number 3163087, or equivalent to coat the inside diameter of the bearing shell.

Use clean 15W-40 oil to lubricate the connecting rod capscrew threads and underside of the connecting rod capscrew heads.
CAUTION

Do not damage the fractured split surface on the connecting rod or connecting rod cap when the connecting rod cap is installed. If the fracture split surface is damaged, the connecting rod and connecting rod cap must be replaced to help reduce the possibility of engine damage.

The connecting rod and cap must have the same number and must be installed in the proper cylinder. The connecting rod cap number and rod number must be on the same side of the connecting rod to prevent engine damage during engine operation.

Install the connecting rod and capscrews.

Use a marked socket and torque wrench to tighten the connecting rod capscrews.

Using the torque plus angle method, tighten the connecting rod capscrews in alternating sequence.

B3.9, B4.5 RGT and B5.9 Engines

Step 2 30 n.m [22 ft-lb]
Step 3 60 n.m [44 ft-lb]
Step 4 Turn 60 degrees clockwise.

B4.5 Engines
Step 6 25 n.m [18 ft-lb]

Step 7 Turn 60 degrees clockwise.

NOTE: Do not measure the clearance between the connecting rod cap and crankshaft.

Measure the side clearance between the connecting rod and crankshaft.

<table>
<thead>
<tr>
<th>Side Clearance Limits</th>
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<tbody>
<tr>
<td>mm</td>
</tr>
<tr>
<td>0.10</td>
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<td>0.33</td>
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CAUTION
To reduce the possibility of engine damage, the crankshaft must rotate freely.

CAUTION
If the connecting rod is not properly oriented (tang opposite the camshaft), it will contact the camshaft and lock the engine.

Check for freedom of rotation as the connecting rod caps are installed. If the crankshaft does not rotate freely, check the installation of the connecting rod bearings and the bearing size.
Measure

Measure piston protrusion above the cylinder block combustion deck.

**NOTE:** For B3.9, B4.5, and B5.9 engines, if piston grading procedure was performed, this measure step is not required.

**NOTE:** For B4.5 RGT engines, this procedure is only required after a piston, crankshaft, connecting rod, or block modification/replacement.

Measure the piston protrusion using depth gauge assembly part number 3823495. No piston or head gasket grading is required.

Install the dial indicator on the cylinder head and zero.

Move the dial indicator directly over the piston pin to eliminate any side-to-side movement. Do not place the indicator tip on the anodized area.
Rotate the crankshaft to top dead center. Rotate the crankshaft clockwise and counterclockwise to find the highest dial indicator reading. Record the reading.

<table>
<thead>
<tr>
<th>B4.5 RGT Piston Protrusion</th>
<th>mm</th>
<th>in</th>
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<tbody>
<tr>
<td>0.151</td>
<td>MIN</td>
<td>0.006</td>
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<tr>
<td>0.485</td>
<td>MAX</td>
<td>0.019</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>B3.9, B4.5, and B5.9 Piston Protrusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
</tr>
<tr>
<td>0.609</td>
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<tr>
<td>0.711</td>
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</table>

If the piston protrusion is not within specification, verify that the correct parts are installed and/or the cylinder block combustion deck has been machined improperly. Refer to Procedure 001-026.

For B3.9, B4.5, and B5.9 engines verify the correct grade of piston is being used. See the Piston Grading section of this procedure.

Check for freedom of rotation as the connecting rod caps are installed. If the crankshaft does not rotate freely, check the installation of the connecting rod bearings and the bearing size.